

Perception and Navigation for Exploration of Shadowed Domains, Phase I

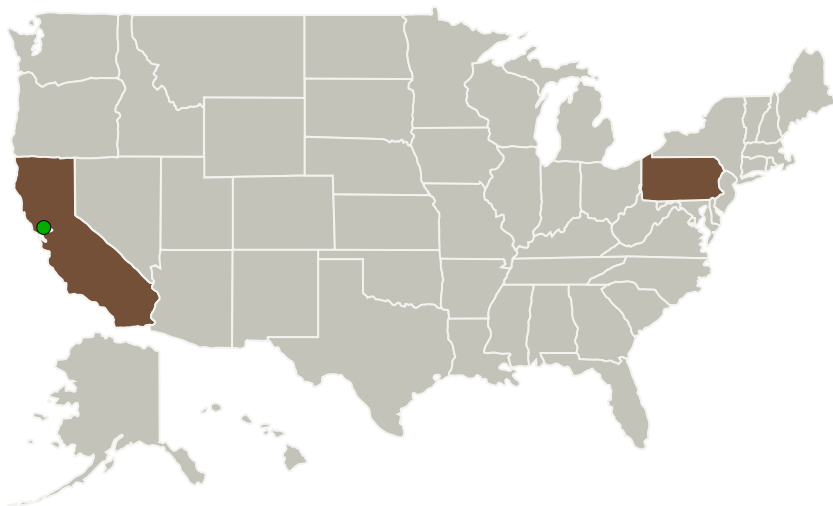
Completed Technology Project (2015 - 2016)



Project Introduction

On-the-ground confirmation of lunar ice will transform space exploration, as ice can provide fuel to support far-reaching exploration and enable commercial endeavors. Evidence from satellite observations strongly supports the presence of polar ice, but driving and excavation are required to confirm presence, measure distribution, and extract resources. In-situ resource extraction at the lunar poles is the precursor for permanent operations on the Moon, Mars, and beyond. The most promising sites for lunar ice lie in the rugged terrain of the permanently shadowed regions at the poles. These destinations demand robust perception and navigation technologies that provide high position accuracy regardless of lighting conditions. Existing rover technologies are incapable of the types of perception and navigation required by the challenges of a dark environment that restrict the rover's ability to perceive its surroundings and overcome inherent positional uncertainty. Even the rover's own shadow can present a significant obstacle while operating in the glancing sunlight of polar regions. The proposed work will develop novel methods for sensing, mapping, and localization in and around the permanently dark regions of planetary bodies. The research will enable the exploration of previously inaccessible dark environments including pits, cold traps, and subterranean voids such as lava tubes and caves on the Moon and Mars. NASA's decadal science survey prioritizes exploration of ancient ices, highlighting a mission to study lunar volatiles in the permanent shadows on the lunar poles. The proposed work innovates perception and navigation technologies to make such polar missions possible.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Astrobotic Technology, Inc.	Lead Organization	Industry	Pittsburgh, Pennsylvania
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania

Primary U.S. Work Locations

California	Pennsylvania
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Project Transitions

**June 2015:** Project Start**June 2016:** Closed out

Closeout Summary: Perception and Navigation for Exploration of Shadowed Domains, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image(<https://techport.nasa.gov/file/139324>)

Images



Briefing Chart Image

Perception and Navigation for Exploration of Shadowed Domains, Phase I
(<https://techport.nasa.gov/image/132747>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Astrobotic Technology, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

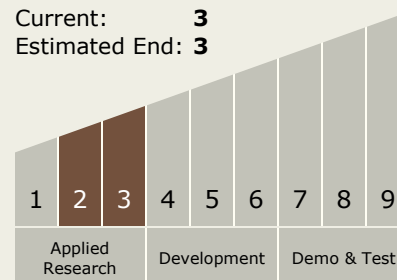
Carlos Torrez

Principal Investigator:

William Whittaker

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



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Technology Areas

Primary:

- TX10 Autonomous Systems
 - └ TX10.1 Situational and Self Awareness
 - └ TX10.1.1 Sensing and Perception for Autonomous Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System